

REMARKS

The Office Action of July 20, 2009 constitutes a final rejection of the claims. The Action and the cited references therein have been carefully studied. Favorable reconsideration and allowance of the claims are respectfully requested.

I. Claim Status and Amendments

Claims 1, 2, and 4-20 presently appear this application. Claims 1, 2, 4-11, and 17-19 have been examined on the merits and stand rejected. Claims 12-16 and 20 have been withdrawn. No claims have been allowed.

By way of the present amendment, claims 1, 6, and 9 have been amended to specify that in the base polyamide nanocomposite of the present invention is it "partially crystalline polyamide" so that there is no amorphous polyamide, as supported by the disclosure, for example, at page 1, lines 10-11, 14, and 16, and at page 2, lines 8-9 and 24, wherein it is disclosed that the polyamide for producing the polyamide nanocomposite is partially crystalline. Support can also be found in the claims as filed and throughout the general disclosure, see for example, page 7, lines 15-24, and 26-28; examples 1 and 2, and table 1 in the corresponding international publication pamphlet WO2004/022651A2.

In addition, claim 1 has been amended to make it clear that the single extrusion procedure is carried out in the double

screw extruder. Support can be found in original claim 1 and in the disclosure, for example, at page 9, lines 18-27 in the corresponding international publication pamphlet WO2004/022651A2.

Step (c) of claim 1 is also amended to correct a typographical error by correctly reference to the previous step (b).

No new matter has been added by the claim amendments.

The claims are believed to be define patentable subject matter warranting their allowance for the reasons discussed herein. Applicants request favorable reconsideration, entry of the present amendment, and formal allowance of the claims.

II. Obviousness Rejection - 35 U.S.C. §103

Claims 1, 2, and 6-11 have been rejected under 35 U.S.C. §103(a) as being obvious over Bagrodia et al. (WO 01/40369) in view of Frank (US 5,217,762) and Umetsu et al. (US 6,121,388) for the reasons on pages 2-5 of the Office Action.

Claims 4 and 5 have been rejected under 35 U.S.C. §103(a) as being obvious over Bagrodia et al., Frank, and Umetsu et al. in view of Maxfield et al. (WO 93/04117) for the reasons on pages 5-6.

Claims 1, 2, 3-6, and 8-11 have been rejected under 35 U.S.C. §103(a) as being obvious over Maxfield et al. in view of Frank and Umetsu et al. for the reasons on pages 6-8.

Claim 7 has been rejected under 35 U.S.C. §103(a) as being obvious over Maxfield et al., Frank, and Umetsu et al. in view of Oswald (US 4,136,103) for the reasons on pages 8-9.

Claims 17 and 18 remain rejected under 35 U.S.C. §103(a) as being obvious over Fujimoto et al. (JP 2000-322919) for the reasons on pages 9-10.

Claim 19 remains rejected under 35 U.S.C. §103(a) as being obvious over Fujimoto et al. in view of Catlin (US 5,819,408) for the reasons on pages 11-12.

On page 13, the Examiner contends that the amendments in the last response necessitated the new grounds of rejection. In this regard, Umetsu et al. is newly cited as teaching the added feature of using a double screw extruder and mixing a polyamide resin composition in stages and adding a later stage polymer through a side feeder. See the top of page 4.

These rejections are respectfully traversed and will be discussed together below. The arguments set forth in the response filed October 20, 2009 are reiterated herein by reference.

The rejections should fall, because the cited prior art references, either alone or when combined, fail to teach, suggest or make obvious all of the limitations of amended claim 1 (which is the sole independent claim under examination), as required to support a *prima facie* case of obviousness.

On pages 11-13 of the Office Action, the Examiner states his reasons in support of the rejections. In particular, as to the rejections over claims 1, 2, and 4-11, the Examiner at page 11, contends that the claims do not exclude the possibility that the first polyamide is amorphous, nor do they exclude the possibility of an oligomer.

In reply, Applicants have amended main claims 1, 6, and 9 to specify that in the base polyamide nanocomposite of the present invention is it "partially crystalline polyamide." As such, there can be no doubt that in the base polyamide nanocomposite of the claimed method, there is no amorphous polyamide. Accordingly, it should be immediately clear to the skilled artisan, upon reading the present application and the claims as amended today, that the partially crystalline polyamide for producing the polyamide nanocomposite is the matrix polyamide of the present invention.

Further, in the response filed October 20, 2009, Applicants presented arguments, as to why the primary reference of Bagrodia et al. (WO 01/40369 A1) is not relevant the instant claims. To reiterate: Applicants again point out that this two-component system differs from the two-component system of the present invention in that:

a) the matrix here in Bagrodia et al. is amorphous, whereas in the claimed invention it is partially crystalline (see claim 1), and

b) the matrix here in Bagrodia et al. is an oligomer, whereas in the claimed invention it is claim 1 is a polyamide (see claim 1).

In doing so, Bagrodia et al. suggests to add layered silicates to a separate oligomer, not to the matrix polyamide, and to disperse the layered silicates in this separate oligomer first, before adding the polyamide to the oligomer/silicate mixture. The Examiner seemingly acknowledges this point at page 3 of the Office Action.

It is noted that an oligomer is not at all a polyamide (see page 3010 in the excerpt of the "RÖMPP CHEMIE LEKION" as attached) or as stated in the "The Free Dictionary" (Internet): An oligomer is a molecule that consists of a relatively small and specifiable number of monomers (usually less than five). Unlike a polymer, if one of the monomers is removed from an oligomer, its chemical properties are altered. As a consequence, the nanocomposite claimed of amended claim 1 does not contain any oligomers.

In view of the above and given the fact that Bagrodia et al. is silent about organically modified layered silicates, and given the additional, fact that claim 1, as amended, defines

a nanocomposite that is composed of nothing else than a partially crystalline polyamide and organically modified layered silicates, there cannot be a *prima facie* obviousness rejection utilizing Bargrodia et al. as "found" by the Examiner (see page 3 of his report), because a skilled person cannot learn from Bagrodia et al. that:

- only a combination of a partially crystalline polyamide and an organically modified layered silicate will lead to a polyamide nanocomposite with superior qualities, and

- all steps of making the polyamide nanocomposite according to the method of the present invention are to be carried out in a single run of a double screw extruder, as claimed.

Further, as discussed in the last response, in Bagrodia et al., the following three components are used: (a) a matrix polymer, (b) an amorphous oligomer, and (c) a layered clay material. These three components may be mixed either by mixing all three components at once in a one step process or in a two step process (see page 23, line 30 to page 24, line 5; and page 38, lines 6-18, page 44, lines 5-9). In the two step process, the first two components - the amorphous oligomer and the layered clay material - are mixed in a first step and then in a second step that melt is mixed with the third component, the matrix polymer (see page 23, line 30 to page 24, line 2, and page 38,

lines 11 to 18). Thus, the layered clay material is not dispersed in the matrix polymer but in the amorphous oligomeric resin, which then serves as a mediator component when mixing with the matrix polymer. Accordingly, Bagrodia et al. teaches to use an additional, third component (the amorphous oligomer) as a mediator for enhancing the degree of dispersion in the nanocomposite, whereas such is not called for in claim 1 of the instant application. Thus, Bagrodia et al. considers the addition of a third component as a relevant solution for solving the above-noted problem, while not recognizing the potential in the mixing step itself.

As a consequence, in order to arrive at the claimed method, a skilled person, when starting with Bagrodia et al. as the closest prior art, has to find a teaching in the prior art disclosing or suggesting:

- To exclude the use of an amorphous oligomer from the production process - exactly to exclude that feature Bagrodia et al. consider to be the solution for solving the existing problems known in the art, and
- To raise the awareness that the mixing order itself is relevant for solving the problem,

However, there is no such teaching in the cited references relied upon by the examiner.

The secondary references fail to remedy the above-noted deficiencies in Bagrodia et al.

As to the secondary reference of Maxfield et al. (WO 93/04117 A1), the arguments set forth in the response filed October 20, 2009 also apply here.

Again, Maxfield et al. refers to a process of forming a polymeric nanocomposite. Maxfield et al. is also confronted with the problem of low dispersibility of layered material in a polymer when producing nanocomposites. Maxfield et al. aims to uniformly disperse, e.g. layered silicates, in a polymer. See page 2, lines 19-21 of Maxfield et al. To solve this problem, Maxfield et al. discloses subjecting a melt mix of polymer and layered material to an additional shearing force, e.g. by transferring the mix into a separate mixer.

Accordingly, Maxfield et al. discloses a two step process comprising: (a) forming a flowable mixture of a melt-processable polymer and a swellable, polymer-compatible layered material, and (b) subjecting said mixture to a shear. The shearing action may be provided, e.g. by mechanical means, by thermal shock, by pressure alteration, or by ultrasonics (see page 29, lines 25-29). A detailed description is given for particular procedures on how best to apply the shear. However, Maxfield et al. explicitly discloses that the manner in which the flowable mixture is formed is not critical and conventional

methods can be employed (see page 7, lines 9 to 11). Thus, similar to Bagrodia et al., Maxfield et al. does not recognize the potential in the mixing procedure itself for achieving a higher dispersibility.

Yet, the Examiner still insists that the selection of a certain sequence of steps in the method would *prima facie* be obvious according to US case law. Applicants respectfully disagree and submit that the present application teaches exactly the opposite of the Examiner's position (see page 14, lines 1-12 in the corresponding international publication pamphlet WO/2004/022651 A2).

Again, to summarize the teaching of Bagrodia et al. and Maxfield et al., the prior art is well familiar with the negative effects of a low dispersibility of layered silicate in a polyamide when producing nanocomposites. Bagrodia et al. and Maxfield et al. suggest different solutions for solving this problem: either to influence the degree of dispersion on a chemical level by adding an additional "mediator component" (Bagrodia et al.), or to apply additional shear forces onto the already existing mixture (Maxfield et al.). Both solutions are complicated and they put additional burden on the settings of the production process. Even more so, both documents do not consider or recognize that modifying the mixing process itself might bear a potential for achieving a higher degree of dispersibility. The

teachings of Bagrodia et al. and Maxfield et al. stand in contrast to, and in no way suggest, the method of claim 1 of the instant application.

Again, the Applicants have recognized for the first time, the potential of the mixing step itself for achieving a higher degree of homogeneous distribution of layered silicate particles in the polyamide of a polyamide nanocompound (see page 13, line 20 to page 14, line 12). Applicants herein claim a production process with a two-component-multi-step mixing carried out in one single extrusion procedure. Indeed, by way of the instant application, the Applicants prove that the way of mixing two components is of high relevance for the degree of distribution of the layered clay particles in partially crystalline polyamide and for the quality of the resulting nanocomposite. This stands in contrast to the teachings of Bagrodia et al. and Maxfield et al.

Applicants again respectfully note that for an obvious selection of an order of mixing steps, the steps must be known. However, in contrast to the Examiner's position, it is not a selection of an order of known steps which is the issue here, but rather the provision of new steps for a mixing process. These new steps are provided in a new order. As these steps are not known in the relevant prior art, it cannot be obvious to select a certain order of steps which are not known per se.

Therefore, Applicants respectfully submit that the examiner's position that the selection of the order of mixing single components or parts thereof would be obvious for a skilled person is - in view of the problem to be solved and in view of the teaching of the cited prior art - simply wrong.

The cited prior art document of Umetsu (US 6,121,388) fails to remedy the above-noted deficiencies in Bagrodia et al . and Maxfield et al. The Examiner points to the use of an extruder side feeder for adding a polymer (see page 4, paragraph 1 of the Office Action). When checking the disclosure in Umetsu (see col. 9, lines 29-49), it was noted that in this case, liquid crystalline resin is added to a melt of a mixture of a polyamide and an acid anhydride (which had previously been inserted together into the extruder via the front feeder). This adding is carried out via the side feeder of, for example, a double screw extruder or other machinery. See also claim 1 of Umetsu. This prior art document is deemed to be irrelevant here, because the subject-matter defines a different composition and because no polyamide is added via a side feeder. The Examiner seems to employ impermissible hindsight by only selecting piece of various prior art documents because some of the teachings therein (here double screw extruder, side feeder) accidentally match with expressions of the claim 1. However, even if the prior art

references were combined they would not arrive at each element of the claims for the reasons discussed herein.

The Examiner seemingly relies on Frank for allegedly disclosing the inventiveness of the filtration step of the claims. Applicants disagree and submit that Frank fails to disclose or suggest that for which it is being offered.

As argued in the last response, Frank discloses a method for the manufacturing of a sheet-like molded article from liquid crystalline polymers by a flat film extrusion die. There is disclosed the filtration of a melt of liquid crystalline fully aromatic polyesters in order to avoid flow irregularities. Accordingly, in Frank, completely different materials are treated with a completely different goal to achieve, as compared to the claimed invention. Thus, completely different materials are treated with a completely different goal to achieve. There cannot be *prima facie* evidence of obviousness under such circumstances, simply because the means used is similar. In other words, in Frank, the filtration step is applied to a single-compound-melt of a completely different polymer. Therefore, Frank does not deal at all with the problem of the present invention, the low dispersibility of layered silicates in a partially crystalline, solid polyamide. Consequently, a skilled person cannot find a teaching that might help him solve the problem to arrive at the method of claim 1 of the present

invention (or the problem of the other cited prior art documents), namely the low dispersion of layered silicates in the melt of a polyamide.

For these reasons, it is believed that the process with a liquid crystalline polymer disclosed in Frank may not be compared with a process with partially crystalline polymers (which are partially crystalline in their solid state). It should be clear that the completely different method in Frank is simply not predictive of the claimed method. It is again respectfully submitted that the Examiner seems to employ the same impermissible hindsight and *ex post facto* reasoning when relying on Frank for allegedly disclosing the inventiveness of the filtration step of the claims.

Accordingly, the cited prior art of Bagrodia et al. and Maxfield et al. disclose methods of producing nanocomposites. Further, both documents refer to the same problem as disclosed by the present invention, a low dispersibility of layered silicates in a polyamide when producing the nanocomposite thereof. However, both documents suggest a solution which renders the procedure complicated. Moreover, both documents do not consider or suggest a solution as provided by the present invention, namely the provision of a multi-step mixing process which is carried out in single extrusion procedure and including a melt-filtration step.

For these reasons, the combination of Bagrodia et al., Maxfield et al., Umetsu et al., and Frank fail to disclose or suggest each and every element of the claims.

Furthermore, as noted in the last response, it is to the references of Bagrodia et al., Maxfield et al. and Frank that the rejections stand or fall, because the Examiner always cites these references in combination with other secondary references, as allegedly disclosing the core process of claim 1. In this regard, the Examiner relies on the secondary references as disclosing the features of dependent claims 7 and 17-19. Further, the remaining secondary references of Umetsu, Oswald, Fujimoto, and Catlin do not remedy the above-noted deficiencies in Bagrodia et al., Maxfield et al. and Frank, because they also do not disclose or suggest method of claim 1, nor the resultant product produced by said method.

Lastly, the Examiner requests that Applicants argue in favor of an inventive step while directing arguments against the cited prior art documents. It is believed that Applicants have done so here and in the last response. As pointed out all ready and again herein, all of the cited prior art documents are silent with respect to the noted two aspects:

- only a combination of a partially crystalline polyamide and an organically modified layered silicate will lead to a polyamide nanocomposite with superior qualities, and

- all steps of making the polyamide nanocomposite according to the method of the present invention are to be carried out in a single run of a double screw extruder. These elements are simply not disclosed in the combined teachings of the cited references. Nor are they predictable from the combined teachings of the references.

There is no other reasonable argument then, because even if a person of (very) average skill would combine the teachings of the above cited documents, he would not arrive at the method of claim 1, as amended.

Lastly, as to the obviousness rejections of claims 17-19 over Fujimoto alone or in combination with Catlin, these references were relied upon for disclosing gas injection molding of thermoplastic resins into parts during injection molding. They mention nothing with respect to the resultant polyamide nanocomposite of claim 1 as a molding compound. Nor do these references remedy the above-noted deficiencies in the other cited references. The Examiner argues that these claims are nested product-by-process claims and Applicants have failed to take this into account.

Applicants disagree. It should be noted that claims 17-19 claims depend, either directly or indirectly, on claim 1. It is believed that the same arguments apply here. Contrary to the Examiner's position, these dependent claims require the

recited features of claim 1, including the use of the resultant polyamide nanocomposite of claim 1 as a molding compound.

Moreover, it is believed that the recited process imparts a structural and/or functional difference on the resultant product as evidenced by the disclosure in the instant application that teaches that the claimed process impacts the degree of dispersion and the surface quality of the produced articles. See for instance, the disclosure at page 14, lines 1-12, wherein it is disclosed that it was surprising that surface quality may be improved by dosing the polyamide in distinct steps. See also Table 2 and the examples therein, i.e., W4320 as an example according to the claimed invention, and W3082_V1 and W3082_V2, as comparative examples. Applicants again respectfully submit that this data demonstrates surprising and unexpected results over anything that could be expected by the combined teachings of the cited prior art, as it is the closest comparison between the claimed invention and analogous compounds.

Thus, the above-noted obviousness rejections should fall, because the combined prior art references fail to disclose or suggest each and every element of independent claim 1, as required to support a *prima facie* case of obviousness. For these reasons, claim 1 and all claims dependent thereon are novel and patentable over the cited prior art references, either alone or when combined.

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Amdt. dated April 20, 2010
Reply to Office Action of January 20, 2010

Therefore, the above-noted obviousness rejections are untenable and should be withdrawn. Withdrawal of the rejections is requested.

III. Conclusion

Having addressed all the outstanding issues, the amendment is believed to be fully responsive to the Office Action. It is respectfully submitted that the claims are in condition for allowance, and favorable action thereon is requested.

If the Examiner has any comments or proposals for expediting prosecution, please contact the undersigned attorney at the telephone number below.

Respectfully submitted,

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APPENDIX:

The Appendix includes the following item(s):

- page 3010 in the excerpt of the "RÖMPP CHEMIE LEKION" as
attached